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DEPARTMENT OF THE AIR FORCE

SUPPORTING DATA FOR FISCAL YEAR 1988/89 BUDGET ESTIMATES

SUBMITTED TO CONGRESS JANUARY 1987

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DESCRIPTIVE SUMMARIES

RESEARCH, DEVELOPMENT, TEST AND EVALUATION

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FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33601F
DoD Mission Area: 333 - Strategic Communications

Title: Milstar Satellite Communications System (AF Terminals)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): (\$ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		117,234	271,968	229,229	310,353	Continuing	N/A
2487	Milstar(AF Terminals)	117,234	271,968	229,229	310,353	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops and acquires Air Force Satellite Communications (AFSATCOM) Ultra High Frequency terminal modifications, transponder test set upgrades, and gap filler AFSATCOM payloads, required for transition to the Milstar satellite system. It also provides resources for development/ acquisition of Milstar Extremely High Frequency terminals for the Air Force. The Milstar satellite system will provide a highly survivable, jam-resistant, worldwide, secure communications system to support the President and the military Commanders-in-Chief for command and control of selected United States strategic and tactical forces in all levels of conflict.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: (\$ in thousands)

RDT&E	124,254	298,527	291,272	N/A	Continuing	N/A
Aircraft Procurement	0	0	0	N/A	Continuing	N/A
Missile Procurement	32,584	0	0	N/A	Continuing	N/A
Other Procurement	0	55,370	0	N/A	Continuing	N/A

EXPLANATION: (U)

(U) RDT&E: FY 1986 and FY 1987 reductions due to Congressional actions. FY 1988 - \$62,043 decrease is sum of a \$24,000 increase to fund the development of mobile/transportable Low Volume Terminals, a Zero Balance Transfer (ZBT) of \$-45,701 to accelerate aircraft terminal procurement for the E-4B (Program Element 32015F), a \$3,880 reduction in Launch Control Center hard antenna development no longer required in near term, a \$23,000 decrease to delay general Missile Weapon System terminal design, a \$-7,400 ZBT to Aircraft Procurement appropriation to fund needed time synchronization units for AFSATCOM terminals and \$-6,062 in profit/inflation adjustments.

(U) Aircraft Procurement: FY 1988 - \$2,900 increase is the sum of a \$7,400 ZBT from RDT&E above to fund Hand Held Module and Time Distribution Subsystems and a \$4,500 decrease to balance budgets among high priority programs.

Other Procurement: FY 1987 reductions due to Congressional action.

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4. (U) OTHER APPROPRIATION FUNDS: (\$ in thousands)

	<u>FY 1986</u> <u>Actual</u>	<u>FY 1987</u> <u>Estimate</u>	<u>FY 1988</u> <u>Estimate</u>	<u>FY 1989</u> <u>Estimate</u>	<u>Additional</u> <u>to</u> <u>Completion</u>	<u>Total</u> <u>Estimated</u> <u>Cost</u>
Aircraft Procurement						
Funds	0	0	2,900	21,673	1,943,300	1,967,873
Quantities	0	0	(420 timing units)	419 terminals	419	
Missile Procurement						
Funds	30,782	0	0	0	Continuing	N/A
Quantities	1	0	0	0	1	N/A
Other Procurement						
Funds	0	725	0	59,681	1,218,409	1,278,090
Quantities (terminals)	0(Spares for ground timing units)	5			296	301
Military Construction						
Funds	0	0	0	5,300	202,931	208,231

5. (U) RELATED ACTIVITIES: Missile Procurement funding in FY 1991 and following procures additional Ultra High Frequency (UHF) transponders on classified host spacecraft to maintain the current Air Force Satellite Communications (AFSATCOM) UHF capability. Procurement and installation of transition upgrades to airborne AFSATCOM terminals to allow UHF compatibility with the Milstar system are funded within the modification line of each weapon system Program Element (PE). Approved transition users include the following PE's: PE 11113F, B-52 Squadrons; PE 11115F, FB-111 Squadrons; PE 11126F, B-1B; PE 11213F, Minuteman Squadrons; PE 11312F, Post Attack Command and Control System/World Wide Airborne Command Post (EC-135); PE 27222F, KC-10A; PE 28019F, Tactical Cryptologic Activities (RC-135); and PE 32015F, National Emergency Airborne Command Post/E-4B Class V Mode. PE 33603F, Milstar Satellite Communications System (Space and Mission Control), will develop and acquire the spacecraft and mission control segments for this highly survivable, jam-resistant, worldwide command and control communications system.

6. (U) WORK PERFORMED BY: Selected terminal modifications for transition of the AFSATCOM system to Milstar are being developed and produced by Rockwell International, Santa Ana, CA, and Linkabit Corp, La Jolla, CA. Remaining AFSATCOM terminal modifications and the Air Force Milstar EHF terminals are being developed by the Raytheon Company, Sudbury, MA., teamed with Rockwell Collins of Cedar Rapids, IA. and Bell Aerospace of Buffalo, NY. Federal Contract Research Center support is provided by the MITRE Corporation, Bedford, MA, and Lincoln Laboratory, Lexington, MA.

7. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

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8. (U) SINGLE PROJECT OVER \$10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: #2487, Milstar Satellite Communications System (AF Terminals)

A. (U) Project Description: The upgrade of Air Force Satellite Communications (AFSATCOM) to Milstar involves both command post and force element terminals and is being executed in multiple steps to maintain strategic connectivity during the transition. Command post terminals in EC-135 aircraft and at selected ground locations will be upgraded to the Milstar Ultra High Frequency (UHF) modulation compatibility in FY 1989-FY 1990 to allow immediate use of the on-orbit Single Channel Transponders and early use of Milstar satellites. In FY 1991 and following, these same terminals plus mobile command posts and satellite mission control elements will be upgraded to full Extremely High Frequency (EHF)/UHF capability. Nine EC-135C command post aircraft are planned to receive early EHF/UHF Engineering Development Model allowing an early EHF injection capability (EHF uplink, UHF downlink) into the first Milstar satellites. The remaining command posts (EC-135H/J/P, E-4B, E-6) will receive full capability starting in FY 1992. Force element terminals will receive the UHF Dual Modem Upgrade starting in FY 1987 and it is expected that at least 450 force element aircraft (B-52, B-1B, EC135A/G, RC135, etc.) will have Milstar UHF capability prior to launch of the first satellite. Finally, force elements will be upgraded to EHF by the mid 1990's providing full jam and scintillation resistant communications capability.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Installation of AFSATCOM UHF terminal dual modem and receiver modifications for compatibility with Milstar began. The Milstar UHF command post transition terminal modifications were fabricated, assembled and extensive in-plant testing was initiated. Full Scale Development (FSD), Phase II of the EHF and EHF/UHF terminals continued. Fabrication of initial EHF terminal hardware was completed and integration began. The Critical Design Review for the B-1B EHF terminal was completed and fabrication of the engineering model was initiated.

(2) (U) FY 1987 Program: Installation of Milstar upgrades to command post and force element AFSATCOM terminals will continue. Field Development Test and Evaluation of the UHF transition command post terminal will be completed. Long-lead will be procured for the transition terminal. Fabrication and integration of three qualification model EHF-EHF/UHF terminals will be completed and qualification and reliability tests will be performed. Setup will begin for in-plant developmental testing and evaluation of EHF terminals planned for December 1987 using the Fleet Satellite (FLTSAT) Communications System EHF transponder package successfully placed into orbit on FLTSAT on 4 December 1986. The upgrade of AFSATCOM host vehicle transponder test equipment will begin. Additional high inclination AFSATCOM transponders will be required in the mid-1990's to maintain strategic connectivity if existing assets survive only to their predicted design life. The existing AFSATCOM transponder design must be upgraded to replace components no longer available. Upgrading the test equipment will allow design and test of a new UHF transponder for host satellites and provide an enhanced capability for testing transponders already on orbit. Concept definition and architecture for a Low Volume EHF Terminal (LVT) will be completed. The LVT design goal 300 pounds as compared with 900 pounds for the standard Milstar EHF terminal. The goal for ground

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Low Volume Terminals (LVT's) is 200 pounds with a very limited capability 50 pound terminal possible. These miniaturized terminals will meet requirements for National Command Authority, advanced aircraft, special forces, and classified survivable communications.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Funding of development of the upgraded Air Force Satellite Communications (AFSATCOM) transponder by the host program office will begin. Major technology insertion development for the LVT will begin. The installation of force element and command post Ultra High Frequency (UHF) radio upgrades to permit fast frequency hopping will begin. The installation of UHF upgrades in force element aircraft and ground terminals as well as production of UHF transition terminals for command posts will continue. Prototype standard terminals will be tested against EHF transponders aboard Navy Fleet Satellites to support a Low Rate Initial Production (LRIP) decision. Most RDT&E funds will be applied to the fabrication and deployment of Engineering Development Model (EDM) terminals for EC-135C aircraft and selected ground sites. These EDM terminals will provide an early capability for very jam resistant cross band operation (Extremely High Frequency (EHF) uplink and UHF downlink) with force element terminals. Additional RDT&E will be applied to fabrication and assembly of conformal antennas for Presidential requirements as well as aircraft and missile systems currently in the design phase. An in-depth evaluation of over 3000 Work Breakdown Structure elements was made using costing analogies, parametric models, contractor estimates, catalog prices, cost estimating relationships and engineering assessments. An Independent Cost Assessment for the core standard terminal program was performed and the results presented to the Office of the Secretary of Defense Cost Analysis Improvement Group on 1 February 1985. A firm price from the Phase II Full Scale Development (PSD) contractor has been included in the current cost estimate. The cost estimates for the LVT and AFSATCOM transponder development programs are currently Category III, Budgetary. The cost estimate for the core standard terminal program is Category I, Comprehensive.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Funding of AFSATCOM transponder development will continue. Detailed design of the LVT will begin. Development of special antennas for advanced aircraft and non-standard ground applications will continue. The installation of force element and command post UHF upgrades will continue. The Initial Operating Capability for the improved AFSATCOM UHF Single Channel Transponder Injection System will be reached. Production and installation of EDM EHF terminals will continue. LRIP of EHF terminals will begin for planned installation beginning in FY 1991. The cost estimates for the LVT and AFSATCOM transponder development programs are currently Category III, Budgetary. The cost estimate for the standard EHF and EHF/UHF terminal development program is Category I, Comprehensive.

(5) (U) Program to Completion: This is a continuing program. Successful testing of LRIP sets against the first on-orbit Milstar satellite will initiate full production, which will continue at least through the mid-nineties.

Budget Activity: 3, Strategic Programs
Program Element: 33601F, Milstar Satellite Communications System
(Air Force Terminals)

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E):

(U) Test Schedule

(U) Air Force Satellite Communications System (AFSATCOM) Upgrade Testing	FY86/87
(U) In-plant DT&E:	FY86/88
- Brassboard/Prototype Testing	FY86/87
- On Orbit Fleet Satellite (FLTSAT) Transponder Tests	FY88
- Reliability/Growth Tests	FY89

Field DT&E/Initial Operational Test & Evaluation (IOT&E)

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(U) AFSATCOM Terminal Dual Modem/ARC-171 Upgrade - To prevent loss of communications during transition between the existing AFSATCOM Ultra High Frequency (UHF) communications system and the new Milstar Extremely High Frequency (EHF) system, existing AFSATCOM terminals are being upgraded to be compatible with the limited UHF capability on the Milstar satellite and jam resistant modes on Single Channel Transponders now present on a variety of host spacecraft. The modifications involve replacement of several circuit boards in existing AFSATCOM modulator-demodulator (MODEM) units and minor ARC-171 radio modifications. Downward compatibility to AFSATCOM is maintained. Most developmental testing of the Dual Modem and ARC-171 radio modifications has been completed and there are no significant discrepancies.

(U) Milstar Terminals - The Air Force awarded a contract for the second phase (post Critical Design Review) of terminal Full Scale Development to the Raytheon Company, Sudbury, Massachusetts in May 1985. Major subcontractors include the Rockwell International, Advanced Communication & Countermeasures Division of Santa Anna, California and Bell Aerospace Textron of Buffalo, New York. The Air Force Milstar Terminal Program Office at Electronic Systems Division has formed a Terminal Test Planning Working Group to coordinate test issues. Detailed test plans arrived to support the February 1985 Critical Design Review. In-plant developmental testing will be accomplished with the Milstar Design Verification Model and satellite test sets. Field level developmental testing will begin first with the launch of the FLTSAT Extremely High Frequency packages and later with the Milstar satellites. Development testing will transition to initial operational testing after checkout of the engineering development model terminals.

2. (U) Operational Test and Evaluation (OT&E): (See also Program Element 33603F Milstar Satellite Communications Program.)

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Program Element: 33601F, Milstar Satellite Communications System
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(U) The Milstar Air Force Terminal Initial Operational Test and Evaluation (IOT&E), being managed by the Air Force Operational Test and Evaluation Center (AFOTEC), will consist of an operational assessment to support a Low Rate Initial Production (LRIP). Additional IOT&E will be included in the Milstar multiservice IOT&E (program element 33603F).

(U) The LRIP assessment will be based on in-plant Development Test & Evaluation (DT&E) testing, review of DT&E test results, and some limited Operational Test & Evaluation (OT&E) analysis. The assessment will estimate the Milstar terminal operational effectiveness and suitability as test assets become available (such as engineering development models, Fleet Satellite Communications (FLTSATCOM) Extremely High Frequency Package, and Developmental Verification Models). Preliminary interoperability with Navy and Army terminals will also be evaluated. In addition to considerable ground testing, a total of 800 hours of DT&E/IOT&E flight testing has been projected in EC-135 and B-52 aircraft. This assessment will conclude in 1990.

Under the multiservice IOT&E, Milstar will be evaluated during simulated and actual operation with Milstar satellites in realistic test scenarios. The multiservice IOT&E test team will form in late 1985 to initiate training and program familiarization. Testing will be conducted with at least two satellites to evaluate cross-link connectivity.

(U) A limited IOT&E(1) program was conducted during the year prior to the February 1985 Critical Design Reviews (CDR) for the Milstar AF Terminal. In the November 1985 final report, AFOTEC listed five concerns which have since been resolved;

(1) (U) Software Security - AFOTEC reported that better software security procedures must be exercised by the contractors during software development and testing. The terminal program office, working with the Computer Resources Working Group, strengthened security procedures. Under the new program; terminal software is developed in a vaulted area, special separate software security monitor code is being developed in a separate area, extensive software reviews have been instituted, access to the software is strictly controlled, and the contractor has been trained and is fully supportive of software security procedures.

(2) (U) Logistics Support Analysis (LSA) - AFOTEC participants in the source selection determined that LSA was not being accomplished correctly. The program office has updated and verified the LSA "A" sheet to reflect more accurate estimates. The update is on revision "G" and is in an iterative update cycle.

(3) (U) Integrated Diagnostics - AFOTEC review of the logistics documents and attendance at Program Design Reviews, led to the finding that the original maintenance concept did not include the use of integrated diagnostics. This problem has been resolved and there is now a fully integrated approach with extensive Built-In-Test at the terminal level as well as Modular Automated Test Equipment (MATE) at the Intermediate and Depot maintenance levels. Compatible software design within the terminal and MATE system will reduce non-reproducible

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(5) (U) Threat - AFOTEC reported that the threat to Milstar was not baselined into Milstar system specifications and that threat documentation did not address the total threat. A new, more detailed Milstar System Threat Assessment Report (STAR) is in process and currently in Defense Intelligence Agency coordination. The new assessment addresses the total system and will permit the specifications to be properly updated, if required.

3. System Characteristics:

<u>Characteristic</u>	<u>Objective/Threshold</u>	<u>Demonstrated</u>
EHF Max Data Rate (kilo-bits/sec)	2.4	To be demonstrated
Bit Error Rate (EHF fully processed)]	To be demonstrated
Bit Error Rate (EHF partially processed)		To be demonstrated
Bit Error Rate (Ultra High Frequency)		To be demonstrated
Anti-Jam Protection, degradation in decibels of Energy-Per-Bit/Noise-Energy for specialized jamming (pulse, chirp, partial band tone, partial band noise.) at 10^{-5} decoded bit-error rate.		To be demonstrated
Terminal Mission Availability (12 hour mission)	.96	To be demonstrated

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4. (U) Current Test and Evaluation (T&E):

<u>Event</u>	<u>T&E Activity (Past 12 Months)</u>		<u>Remarks</u>
	<u>Planned Activity</u>	<u>Actual/Predicted Date</u>	
Dual Modem Upgrade Qual Part I	Dec 85	Apr 86	Delayed by alarm & synthesizer problems
Milstar Terminal-Payload Breadboard	Jan 86	Jan 86	Against Spacecraft Breadboard on ground
ARC-171H Physical Configuration Audits	Feb 86	May 86/Sep 86	Synthesizer Card/Control Monitor complete
Milstar Terminal Prototype Test	Oct 86	Nov 87	Restructured to be against develop model
Dual Modem Upgrade Qual Part II	Jan 87	Apr 86	Combined with Part I tests
Dual Modem Physical Configuration Audit	Feb 87	Apr 86	
Initial plans for LRIP Test Approach	Oct 86	Feb 87	In Test & Evaluation Master Plan
Finalize LRIP Test Plan	Jan 86	Mar 87	
Activate LRIP Assessment Team	Mar 86	Mar 87	Adjusted to reduce manpower requirements

<u>Event</u>	<u>T&E Activity (Next 12 Months)</u>		<u>Remarks</u>
	<u>Planned Date</u>		
Updated Test & Evaluation Master Plan	Feb 87		
Dual Modem Field Compatibility Test	Feb 87		Verify channel 1.5 in field
Milstar UHF to Payload Test (Ground)	Feb 87		Waveform compatibility test
Milstar UHF to On-Orbit AFSATCOM	Jun 87		AFSAT and Single Channel Transponder
Milstar EHF to Ground FRP Unit	Jun 87		At Lincoln Laboratory
EHF/UHF System Compatibility	Nov 87		
Milstar EHF to FLTSAT EHF Package	Dec 87		
Test Program Outline Revision	Feb 88		

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C. (U) Major Milestones:

<u>Milestones</u>	<u>Dates</u>
(1) (U) Milstar Terminal Full Scale Development (FSD) Start	September 1983
(2) (U) Extremely High Frequency (EHF) Preliminary Design Review	June 1984
(3) (U) EHF Terminal Critical Design Review	February 1985
(4) (U) Phase II FSD Contract Award	May 1985
(5) (U) Start of EHF Terminal Qualification Model Integration	August 1986
(6) (U) Ultra High Frequency Transition Contract	July 1987
(7) (U) Milstar Low Rate Initial Production Start	FY 1989

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.